United States Environmental Protection Agency
Region 5

Date: October 2, 2000

Subject: High Sensitivity Metal Detector (EM61) & Cesium magnetometer Survey

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Magnetometer Survey

To: Carla Auker
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CC: Steve Ostrodka, Chief: Field Services Section

At your request, a geophysical survey was conducted on September 14, 2000 in an area referred to as the Sam Winer Motor (gas station property) site located on East Waterloo Road near Akron, Ohio. This site was evaluated as an emergency site coordinated from the USEPA's Westlake, Ohio office. Present at the survey were J. Ursic, Carla Auker USEPA Region 5; Justin Bowerman, James Justice USEPA START; and Vicki Deppisch from Ohio EPA.

The purpose of this survey was to investigate the Sam Winer site to determine underground metallic objects exist in the site area. A Geonics high sensitivity metal detector (with the narrow coil configuration) commonly referred to as an EM61, was used to investigate the area. Two concrete pads were re-surveyed with a Geometrics G858 cesium magnetometer in an effort to determine if ferrous tanks exist below the concrete.

Theory

Electromagnteics

The EM61 is a time domain system which generates electromagnetic (EM) pulses from a coil at 150 time per second, while taking measurements during the off-time between pulses. After each pulse, secondary EM fields are induced briefly in a moderately conductive earth, and for a longer time in metallic objects. Between each pulse, the EM61 waits until the repose from the conductive earth dissipates, and then measures the prolonged buried metal response. In this way the EM61 only measures the response from buried metal, both ferrous and non-ferrous metal, which is measured in millivolts (mV). This system is also known as a time domain metal detector.

The EM61 consists of two receiver coils (a top and a bottom coil) which is very helpful in the recognition of near surface objects from deeper objects. Since the amplitude of the response

is highly dependent on the distance between the coil assembly and target, small near surface targets will very often produce a response orders of magnitude larger than targets having greater size a deeper depths. This masking effect form the near surface materials is drastically reduced by processing output of the two coils, essentially subtracting the bottom coil data from the top coil data (this is called the differential mode). It should be noted however, surface debris can still have an effect on the differential readings if there is sufficient quantity present.

The vertical detection limit of the EM61 is approximately between ten and fifteen feet.

Magnetometer

A cesium magnetometer measures interactions between magnetic fields and the ionization of cesium gas. Cesium gas when ionized will release more energy when in the presence of a strong magnetic field, such as those found associated with ferrous metal, than in a weaker field. The cesium magnetometer uses sensors that contain cesium gas and a constant ionizing light source which allows for continuous data collection. When exposed to strong magnetic fields, the ionization of the cesium gas is more rapid as the field tends to force the ionized electrons back to a stable state, thus requiring more ionizing energy. Loss of energy is in the form as light as the ionized cesium gas returns to its stabilized state. This light energy is measured by photomultiplier electronics in proportion to the total magnetic field intensity and converted to units normally used for magnetics such as gammas or nono-teslas. Data recorded using two sensors simultaneously (referred to as the gradient mode) is capable of reducing the effect of interference from changes in the earth's magnetic field. Units of measurement in this report were recorded in gammas per meter.

The vertical detection limit of the cesium magnetometer is dependent on the ferrous mass of the object and distance to the sensor. Small masses far from the sensor will be less likely to be detected than a large ferrous mass buried several feet below the ground.

Procedure: Electromagnetic Data

Survey area for the Sam Winer site was approximately 0.46 acres. A survey grid was established using measuring tapes and flagging to provide a systematic method for data collection. The base point for the grid to collect electromagnetic data was established 30 feet south of the centerline of East Waterloo Road and 44 feet west from the west edge of the concrete pad (nearest to E. Waterloo Road) which lies near the center of the surveyed area.

Data were collected every 0.655 feet on alternating east-west traverse lines spaced 5 feet apart in the north-south direction and stored automatically on a digital data collector. Line positioning was maintained using survey flags set on a north-south lines at the end of each line These flags helped the operator maintain traverses for each line.

Procedure: Magnetic Data

Magnetic data were collected over 7,000 square feet on north-south traverses which were space 5 feet apart in the east-west direction. Data were collected and averaged ten times per second during normal walking pace traverses. The base point was established so that the west edge of "Concrete Pad A" was position 0 for the y-axis and the southern edge of "Concrete Pad B" was line 0 for the x-axis (see Figure 2). Line positioning was maintained using measuring tapes placed at the ends of the lines.

Interpretation: Electromagnetic Data

The EM61 survey results were plotted using differential data from both EM61 coils to isolate deeper targets from near surface debris. Data were plotted using Surfer® version 7.00 after being collected using Geonics® DAT61W version 1.01.

Five areas were noted of having significant amounts of subsurface metal, but other minor anomalies may be of concern dependent on what limitations are chosen to be of concern (i.e. how minor is minor). In either circumstance, all data have been contoured and plotted on Figure 1. The most significant anomaly is found in the area noted as "Concrete Pad A" and is most likely due to metal reinforcement within the concrete. Linear features to the west of Pad A are probable locations of underground pipes. Areas marked as "Anomalous Areas 1" and "Anomalous Areas 2" match the general outline of where material which appeared to be metal slag could be seen at the ground surface. The location noted as "Concrete Pad B" did not appear to have as much reinforcement to the concrete as Pad A. However, a metal bar was seen embedded in the concrete which did produce a significant anomaly as did an area just west of a hole in the concrete. An area southwest of Pad B appears to have a possible extension of a pipe or similarly shaped object.

Note that background for electromagnetic data is approximately 0 millivolts (mV). Anomalies are those values which are either significantly higher or lower than background.

Interpretation: Magnetic Data

Magnetic results were plotted using uncorrected total field data from a Geometrics G-858 cesium magnetometer. Data were plotted using Surfer® version 7.00 after being collected using Mag-mapper Revision B.

The magnetic survey was conducted to determine if any significant ferrous mass existed beyond the known mass of ferrous reinforcing material in the concrete and the amount of mass due to what appears to be areas of slag.

Location noted as "Concrete Pad A" seems to have uniform mass with the exception of four areas. An area in the southeast corner has an anomaly which is due to ferrous debris which can be seen on the ground surface. Another anomaly was noted near line 40, position 100 (under the power-line) which is probably due to a small ferrous mass just outside the survey boundary.

Near the area noted as "M6" is an anomaly which appears to lie between gaps in the concrete of unknown origin. A slightly higher anomaly is also noted on pad A near line 0, position 74.

Magnetic data from "Concrete Pad B" seems to be dominated by the metal bar which can be seen embedded in the concrete. However, another anomaly may exist near line 25, position 10.

Anomalies marked as "M1", "M2", "M3" and "M5" are probably due to significant pieces of slag which is at or near the ground surface and are probably not storage tanks. The ground surface found near area "M4" did not appear to have any visible slag at the surface, but the "M4" anomaly may be due to slag not visible from the ground surface or a small tank.

Note that background for magnetic total field data is approximately 54,300 gammas. Anomalies are those values which are either significantly higher or lower than background.

Conclusions

Geophysical surveys were able to delineate areas where the subsurface was most likely altered due to previous activities at the site. However, due to the probable backfilling of slag, the electromagnetic results are not as definitive as hoped (with the exception of anomalies located west of Pad A). The magnetic anomalies were able to distinguish amounts of mass and associated footprints which indicate that most of the significant anomalies seem to be point targets, probably due to individual pieces of slag. Those magnetic anomalies which appear to have larger footprints (possibly tanks) may exist in several areas noted in Figure 2 as "M4", "M6" and possibly under concrete Pad B, east of the drain. A slight possibility exists that a small tank may be located near line 0, position 74 (Figure 2).

Several linear anomalies were found using electromagnetic data and have a high probability of being buried pipes. These are noted on Figure 1.

Further investigations using other geophysical equipment, such as ground penetrating radar (GPR), will have limited benefits since areas having slag will resist penetration of the signal. However, GPR may offer an indication of what lies beneath the concrete pads and possibly location "M4", if "M4" is slag free.

Cautions!

If it is determined that excavation of the area is necessary, the following advice is offered. It is imperative that utility location services be contacted to establish the exact location of any buried utilities or pipelines before any digging is conducted. Use caution and proper Occupational Safety and Health Administration (OSHA) stand-off distances near overhead or buried utility lines. Anomalies should be excavated in an order starting with the most significant anomaly values and ending with those nearest background. Excavation should not begin directly over the suspected target, it should be offset from the target and gradually advanced into the target location. This reduces the chance for damaging a target mass. Proper procedures should

be initiated immediately if hazardous wastes are encountered.

Thank you for the opportunity to conduct this survey and if you have any questions, please contact me at 312/353-1526.

Attachments: Figures 1 & 2

EM61 High Sensitivity Electromagnetic Metal Detector Data

Sam Winer Motor Site - Akron, Ohio

(Gas Station Property)

Survey Date = 9/14/00

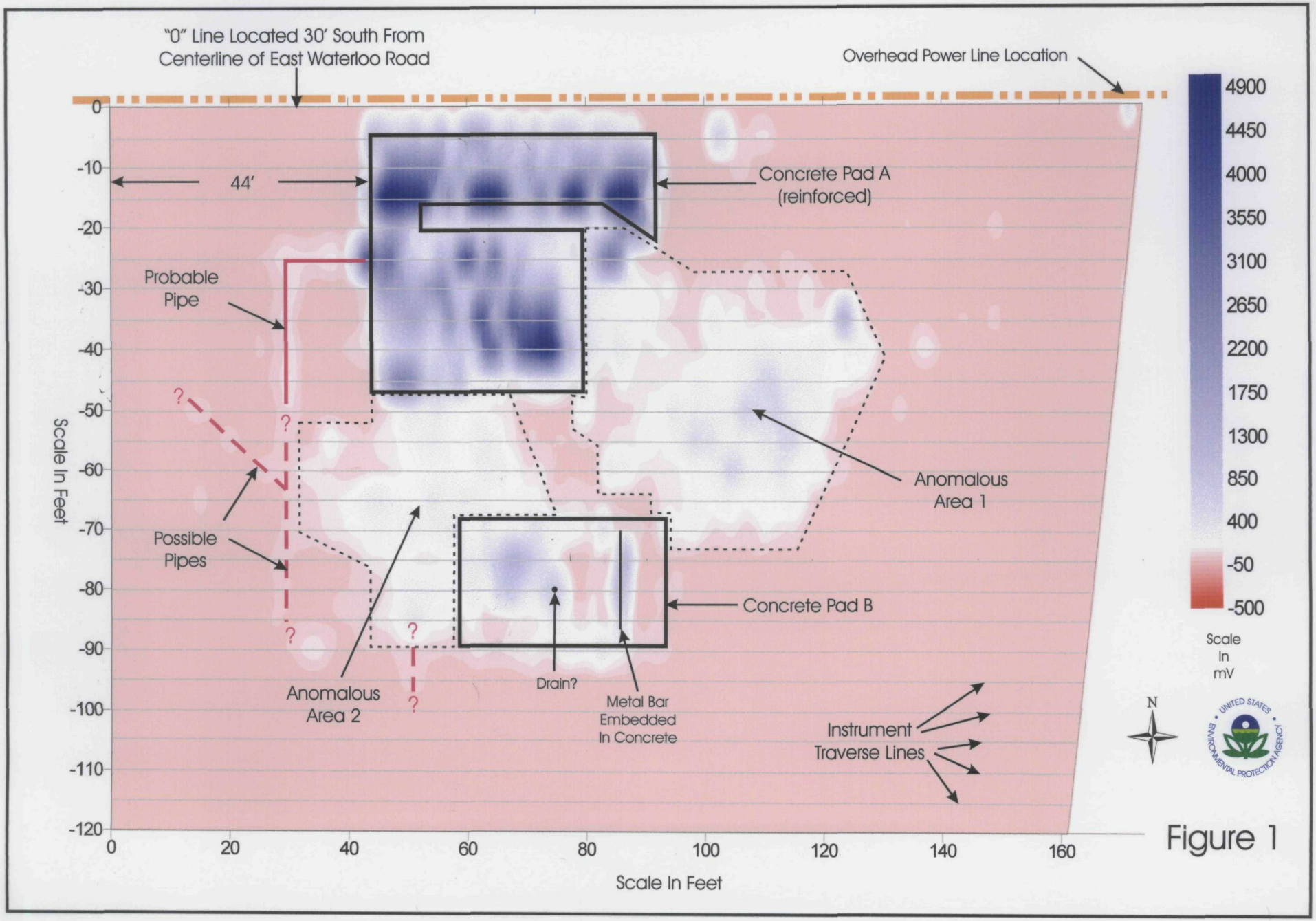

Figure 1

Cesium Magnetometer Total Field Data

Sam Winer Motor Site - Akron, Ohio

(Gas Station Property)

Survey Date = 9/14/00

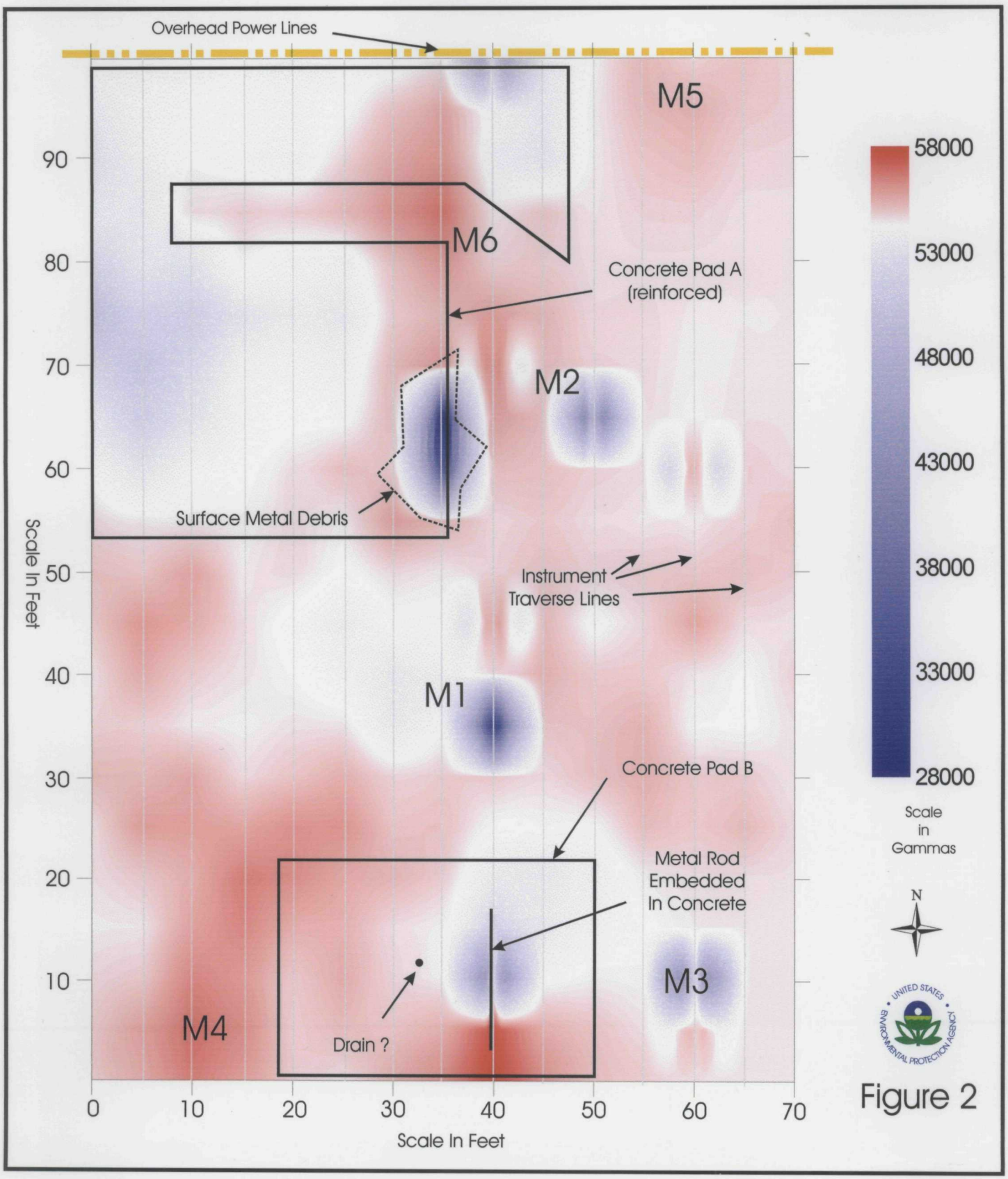

Figure 2